Technical Assistance Services *for* Communities

Report on OU4 Design Study and Pilot Study

Contract No.: EP-W-13-015
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Site Name: DePue/New Jersey Zinc/Mobil Chemical Corp. Superfund Site
Site Location: DePue, Illinois

Purpose

In January 2014, the DePue Community Advisory Group (CAG) requested a review of the DePue/New Jersey Zinc/Mobil Chemical Corp. Superfund site (the Site) 2012 Operable Unit (OU) 4 Off-Site Soils Design Study (Design Study) and 2013 OU4 Pilot Study Work Plan (Pilot Study) by the U.S. Environmental Protection Agency's (EPA's) Technical Assistance Services for Communities (TASC) program. Independent technical and environmental consultants implement the TASC program. The report's contents do not necessarily reflect the policies, actions or positions of EPA. TASC has provided this report to residents of DePue including members of the DePue Superfund CAG.

Community Concerns Identified by the CAG

Community members identified several site-related concerns with the OU4 Design Study and Pilot Study, listed below.

- Lead cleanup levels
- Risk to private gardens
- Arsenic cleanup levels
- Soil sampling methods
- Risk from multiple OUs

Site Background

The Site is located along the north side of the Village of DePue and includes about half of the village's land area. The cleanup has been divided into five OUs for investigation and remediation:

- OU 1: South Ditch Contaminated Sediments
- OU 2: Phosphogypsum Stack
- OU 3: Former Plant Site Area
- OU 4: Off-site Soils
- OU 5: DePue Lake Sediments and the Flood Plain

A design study for the investigation, remediation and restoration of contaminated properties in OU4 is underway. The OU4 Design Study proposes "bright-line" cleanup goals developed for

site-related chemicals of potential concern (COPCs) and to be applied as the cleanup goals. If any sample exceeds these goals, the area where the sample was taken (e.g., a quadrant) must be excavated. This approach is considered conservative. However, targeting all samples exceeding the remedial goal for cleanup ensures that residual contamination will not pose unacceptable risks, especially if exposure were to occur in a very localized area (e.g., a child plays only in the area where the highest concentration is detected).

Site-related COPCs were initially identified in the Design Study following a similar approach under Superfund. A subset of metals were identified as human health COPCs, or HCOPCs (i.e., arsenic, barium, cadmium, chromium (if hexavalent), lead, manganese and zinc), for off-site soils by comparing the maximum detection of the data set to the lowest available human health criteria (i.e., the conservative human-health-based screening levels) among:

- U.S. EPA (2010) Regional Screening Levels for residential soil
- Illinois EPA (IEPA) remediation objectives from Tiered Approach to Corrective Action Objectives for the inhalation and ingestion exposure routes for residential properties and construction workers

The data set relied on by the HCOPC process included results from 65 surface soil samples collected in December 1992 and 20 surface soil samples collected in March 1992 by Illinois Environmental Protection Agency (IEPA).

Prior to finalizing the Design Study, a pilot study of a randomly selected subset of residential properties is underway to answer several key questions that will inform the Design Study. Prior to conducting full-scale soil investigations, the goals of the pilot study are to determine:

- The generalized depth of potential plant-related fill material.
- If the lead concentration in the fine soil fraction is different from the lead concentration in the total sample.
- If concentrations in the 0 to 1 inch soil samples are similar to concentrations in the 1 to 6 inch sample, thereby eliminating the need for collection of the 0 to 1 inch sample during implementation of the Design Study. If the data allow for elimination of the 0 to 1 inch sample interval, future sampling will be conducted from 0 to 6 inches.
- The ability to refine the list of HCOPCs.
- If chromium is present in the more toxic hexavalent or less toxic trivalent forms.
- The adequacy of x-ray fluorescence (XRF) technology and define the terms of its use during implementation of the Design Study.
- Evaluate the practicality of the assumptions and plans outlined in the Design Study.

Lead Cleanup Levels

Although exposures to lead are known to cause adverse effects, EPA has not recognized toxicity data with which to determine risk-based cleanup goals for lead. Other health authorities, such as Centers for Disease Control and Prevention (CDC), and the Agency for Toxic Substances and Disease Registry agree that it may be inappropriate to develop and use toxicity factors for lead since there may not be a true threshold for the effects of lead. As a result, EPA considers lead to be a special case and relies on alternative methods for evaluating the toxicity of lead.

EPA therefore evaluates lead exposure by using blood lead modeling for evaluating child and adult exposures since chronic health effects associated with lead exposure have been related to elevated blood lead levels (BLLs). Specifically, EPA uses the Integrated Exposure-Uptake Biokinetic Model (IEUBK) to evaluate children and the Adult Lead Model (ALM) for assessing nonresidential adult exposures to lead in soil. The ALM uses a methodology to relate soil lead intake to blood lead concentrations in women of child-bearing age. Both the IEUBK and the ALM evaluate exposures to lead as well as calculate lead cleanup goals in soil.

EPA established a national health criterion that specifies that no more than 5 percent of the population exceed a blood lead level of 10 micrograms per deciliter (µg/dL). This BLL is based on analyses by the CDC and EPA that associate BLLs of 10 µg/dL and higher with health effects in children. The BLL of 10 µg/dL continues to be used by EPA as a basis for risk management decisions at Superfund sites until EPA's Technical Work Group for Lead and EPA's Office of Solid Waste and Emergency Response have completed their review of more recent information from the CDC. In January 2012, the CDC recommended the use of a BLL of 5 µg/dL as the reference value to identify children with elevated BLLs. CDC's recommendation is based on studies with a large number and diverse group of children with low BLLs and associated IQ deficits.

EPA's Office of Solid Waste has released a detailed directive on risk assessment and cleanup of lead in residential soil (EPA, 1994). The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use, assuming the exposure assumptions used in the IEUBK model are consistent with site conditions. In addition, EPA established a screening level of 800 mg/kg for adult workers. Above these screening levels, EPA suggests collecting data and modeling blood lead levels with EPA's child and adult blood lead models. The Tier 1 values for lead under TACO adopted the EPA values of 400 mg/kg and 800 mg/kg for residential and industrial exposures, respectively.

As an alternative to conducting additional lead exposure modeling to evaluate whether site-specific conditions may support higher acceptable levels of lead, cleanup can be demonstrated by achieving an average concentration of lead in the exposure area at a Superfund site (e.g., a residential yard) of less than 400 mg/kg. However, caution should be used when both water and soil exposures are being assessed. The blood lead models can result in lower cleanup goals for lead if the average soil concentration is 400 mg/kg and lead in ground water exceeds 5 micrograms per liter (µg/L). Further, some states are using more stringent assumptions in their lead models to reflect more recent information released from the CDC on the toxicology of lead to children.

IEPA requested the incorporation of the reference value of 5 µg/dL BLL in the calculation of the Site's soil criterion for lead. When incorporating the CDC reference value of 5 µg/dL BLL into the IEUBK, the residential criterion for a residential child is reduced from 400 mg/kg to about 150 mg/kg.

The Integrated Exposure Uptake Biokinetic (IEUBK) Model
The IEUBK model is used in assessing risks associated with residential child exposures to lead in soil. EPA developed the IEUBK model to enable predicting the relative effect of an increase in BLL in children under 7 years old who are exposed to environmental lead from many sources. IEUBK predicts the risk (the probability) that a typical child exposed to specified media lead concentrations will have a BLL ≥10 μg/dL, which is the BLL of concern.

IEUBK can also predict residential soil lead cleanup levels based on exposure to lead via diet, air, drinking water and soil. The amount of soil/ indoor dust ingested per day has the most impact on the predicted BLL and total lead uptake. The recommended soil ingestion rates take into account exposure from indoor dust. Sampling of indoor dust may be appropriate to quantify indoor dust ingestion exposures where excessive soil disturbance near the residential area which may generate more dust than anticipated.

The model is a four-step process that mathematically and statistically links environmental lead exposure to blood lead concentrations for a population of children (0-7 years of age).

1. *Exposure Component:* calculates daily lead intake rate into the body from ingestion and inhalation of soil/dust, food, drinking water.
2. *Uptake Component:* how much lead is actually absorbed in the body.
3. *Biokinetic Component:* estimates transfer rates for lead moving between compartments and through elimination pathways to derive a predicted long-term steady state geometric mean blood lead concentration.
4. *Variability:* estimates a plausible distribution of BLL for a given hypothetical population of known lead exposures.

Adult Lead Model (ALM)
EPA's ALM is used in assessing risks associated with non-residential adult exposures to lead in soil. The ALM is a simplified biokinetic model; a biokinetic model assesses the routes of human exposure to substances and determines the distribution of the substances among the various body tissues in humans. Biokinetic models are used when there is a known effect associated with a specific tissue concentration in humans. The ALM has the ability to either calculate BLLs associated with a given soil lead concentration, or calculate a preliminary remediation goal for lead in soil given a target BLL.

The ALM methodology focuses on estimating fetal blood lead concentration in women exposed to lead-contaminated soils for evaluating risks of elevated blood lead concentrations among exposed adults. In the commercial/industrial setting, the most sensitive receptor is the fetus of a worker who develops a body burden of lead as a result of non-residential exposure to lead. This body burden is available to transfer to the fetus for several years after exposure ends. Cleanup goals that are protective of a fetus will also afford protection for male or female adult workers.

Risk to Private Gardens
IEPA requires development of cleanup goals for those metals, including cadmium, that may be bioavailable to plants. IEPA also requires a determination whether arsenic, mercury, nickel, selenium and zinc should be included as COPCs in gardens.

- *Lead:* cleanup goals for lead are derived using the IEUBK model, which accounts for lead uptake in home-grown vegetables. Specific information on the IEUBK model is not included in the Design Study and should be included in the final version.
- *Other Metals:* for metals other than lead, the recommended generic plant soil screening levels from the USEPA Soil Screening Technical Background Document, Appendix G, May 1996, are included for OU4.

The final Design Plan should specifically outline the identification and sampling of private gardens, including raised bed gardens.

Arsenic Cleanup Goals
For arsenic, IEPA requires soil cleanup to background concentrations in cases where health-based levels are more stringent than background levels. For the Site, the applicable background concentration would be 11.6 mg/kg. The responsible party group (DePue Group) has requested use of in-vivo studies to support a less stringent cleanup goal. IEPA has indicated it will not accept the in-vitro bioavailability studies or the less stringent cleanup goal for the Site. TASC agrees with IEPA's position that cleanup of arsenic to background concentrations is appropriate for OU4.

Soil Sampling
The Design Study and Pilot Study outline soil sampling methods proposed for OU4. IEPA reviewed the Design Study and indicated that the study did not clearly describe how compliance with cleanup criteria will be demonstrated. In June 2012, IEPA provided two recommendations to the DePue Group on how to demonstrate properties requiring remediation and how to demonstrate when a property has been remediated sufficiently. TASC agrees with IEPA's requirement that the Design Study needs to outline a process for determining compliance with the cleanup goals. The options offered by IEPA would be appropriate.

Statistical Assessment of 0 to 1 Inch and 1 to 6 Inch Soil Samples
An objective of the Pilot Study is to determine if concentrations in the 0 to 1 inch soil samples are similar to concentrations in the 1 to 6 inch sample, thereby eliminating the need for collection of the 0 to 1 inch sample during implementation of the final Design Study. If the data allow for elimination of the 0 to 1 inch sample interval, future sampling will be conducted from 0 to 6 inches. With respect to risk assessment, the top inch of soil best represents current exposure to contaminants and is the source of data used in the IEUBK model to represent exposure from soil. The lower soil horizons represent possible future exposures, such as homeowner projects, children's play areas and other home activities that periodically extend beneath the top inch of vegetation/soil.

Such an approach is allowable under EPA guidance. EPA states that samples should be collected to define the vertical extent of contamination. Five-point composite surface soil samples should be collected from 0 to 1 inch for human health risk assessment purposes. After collection of a

statistically valid number of 0 to 1 inch and 1 to 6 inch samples, the project manager may want to statistically compare both sample horizons to determine if the 0 to 1 inch depth can be eliminated and future sampling can focus on the 0 to 6 inch depth to further decrease sampling costs.

However, EPA guidance specifically questions the appropriateness of this approach at smelter sites:

"This may be particularly useful at mine waste sites where contamination often extends to depth or at sites where lead-contaminated soil has been used as fill material; in such cases, the lead concentration may increase with depth. Conversely, the 0–1" horizon may be far more contaminated than the 1–6" at smelter sites, making individual horizon sampling crucial to remedial decision-making."

The Design Study indicates the source of soil contamination is due to plant-related fill material and aerial deposition from the zinc smelter. Therefore, the appropriateness of this approach, as well as the specific sampling locations for conducting such an assessment, are not fully supported in the Design Study or the Pilot Study. TASC believes that both the statistical evaluation of the two sample horizons and the appropriateness of sample locations in relation to expected aerial deposition locations should be scrutinized prior to making any decision regarding the elimination of the more precise 0 to 1 inch soil interval.

Risk from Multiple OUs

The potential for receptors to be exposed in multiple OUs (e.g., a resident in OU4 may also be a trespasser in OU3) indicates the OU-specific risk assessments may underestimate the risks to DePue residents. In its June 2012 letter, IEPA requested that the Design Study clarify how risks from multiple OUs will be addressed at the Site. IEPA stated it intends to reject any plan that does not address this concern, and that it would consider the adoption of the most stringent cleanup criteria for each contaminant. EPA does offer guidance on quantifying intermittent or variable exposures to lead, which may be applicable at the Site. TASC agrees that the final Design Study should address risk from multiple OUs, either in a quantified assessment or as a rationale for why application of the most stringent criteria would ensure no occurrence of unacceptable risk.

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